Improvements relating to electric protective cut-out arrangements

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Application number:	GB19530007059 19530313
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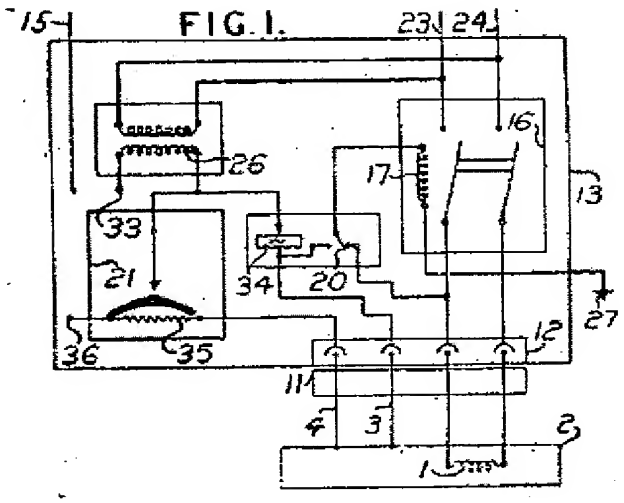
Abstract of **GB735908**

735,908. Protective cut-out arrangements. SIEMENS ELECTRIC LAMPS & SUPPLIES, Ltd. March 5, 1954 [March 13, 1953], No. 7059/53. Class 38 (5). Apparatus 1 fed from line and neutral wires 23, 24, respectively, over a circuit-breaker 16 and plug coupling 11, 12, has its metal casing 2 connected by earth wires 3, 4 to an earth- leakage and earth-continuity protective device 13 which is operative at once if the earth continuity is broken or a serious leak occurs, and after a time lag if the leak is moderate. Normally the low-voltage secondary 26 ener- gizes a monitoring relay winding 34 over the earth wires 3, 4, heating coil 35 of a bimetallic switch, and terminals 33, 36 on the earthed frame of the device 13, the contact spring set 20 being thus moved to the left. If a leak occurs such as to produce an excessive voltage on earth wire 3, the trip coil 17 is at once energized therefrom over auxiliary earth 27. With moderate leaks the switch 21 closes to short-circuit the secondary 26 and de-energize relay 34, whereby contacts 20 connect the trip coil 17 to earth 27 directly from the line wire 23. In a modification adapted to trans- portable apparatus (Fig. 2, not shown), the connection 33 is taken back to the main supply earth to which the earth wire 15 is connected, so including these wires in the earth-continuity protection.



PATENT SPECIFICATION 735,908

Inventor :—JACK BRUNWIN.

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Index at Acceptance :—Class 38(5), K1(B : F), K(11 : 19).

COMPLETE SPECIFICATION.

Improvements relating to Electric Protective Cut-Out Arrangements.

We, SIEMENS ELECTRIC LAMPS AND SUPPLIES LIMITED, of Caxton House, Tothill Street, Westminster, London, S.W.1, a Company registered under British law, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to electric protective cut-out arrangements, and has in view the provision of improved electric protective cut-out arrangements for automatically disconnecting a protected circuit from a source of supply on the occurrence of an earth leakage fault in the protected circuit.

The earth leakage protective cut-out arrangements of the invention are such that disconnection of a protected circuit is effected substantially immediately on the occurrence in the protected circuit of an earth leakage fault which is sufficiently serious to cause the potential of an earth wire of the protected circuit to differ by more than a predetermined amount from that of an auxiliary earth, and is also effected in response to a less serious earth leakage fault in the protected circuit provided that the fault persists for a sufficient time. The preferred earth leakage protective cut-out arrangements embodying the invention are further such that the continuity of the earth wire system of the protected circuit is continuously monitored.

According to one feature of the invention, electric protective cut-out arrangements for automatically disconnecting a protected circuit from a source of supply on the occurrence of an earth leakage fault in the protected circuit are such that an earth leakage circuit-breaker serves for connecting the protected circuit to the source of supply, that a trip coil of the earth leakage circuit-breaker is normally connected between an auxiliary earth and an earth wire of the protected circuit, and that the winding of a thermal relay is normally connected between the said earth wire and the local earth (usually termed the solid earth) associated with the source of supply, this thermal relay serving to bring about the effective energisation of the trip coil of the earth leakage circuit-breaker in response to a persistent earth leakage fault current in the protected circuit which is not sufficiently serious to cause this trip coil to be effectively energised by virtue of its connection between the said earth wire and the auxiliary earth.

According to another feature of the invention, the thermal relay on operation brings about the effective energisation of the trip coil of the earth leakage circuit-breaker by bringing about the connection of this trip coil between the auxiliary earth and one of the main line wires of the protected circuit.

According to a further feature of the invention, the thermal relay on operation brings about the effective energisation of the trip coil of the earth leakage circuit-breaker by bringing about the release of a monitoring relay which is normally maintained operated in dependence upon the continuity of the earth wire system of the protected circuit, this monitoring relay having contacts which whilst operated connect the trip coil of the earth leakage circuit-breaker between the auxiliary earth and the said earth wire of the protected circuit, and which whilst unoperated connect this trip coil between the auxiliary earth and one of the main line wires of the protected circuit.

By way of example, two contemplated specific embodiments of the invention will now be described with reference to the accompanying drawing. Fig. 1 of the drawing is a circuit diagram showing the circuit of the first of these two embodiments, and Fig. 2

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is a further circuit diagram showing how the circuit of the second of these two embodiments differs from that of the first.

Referring firstly to Fig. 1, the embodiment to which this figure pertains takes the form of electric protective cut-out arrangements for use with an alternating current supply and comprising a protective unit having a multi-pin socket into which is inserted the corresponding multi-pin plug of a plug-terminated circuit to be protected. The figure is purely a circuit diagram, and is not intended to show the relative sizes and dispositions of the parts of the protective unit. The protected circuit will be assumed to comprise portable apparatus 1 having a metal casing 2 which is connected by a first earth wire 3 to a first earth pin 7 of the plug 11 and which is connected independently by a second earth wire 4 to a second earth pin 8 of the plug. The remaining pins 9 and 10 of the plug 11 are main line pins connected by main line wires 5 and 6 of the protected circuit to the terminals of the apparatus 1 within the casing 2. The wires 3, 4, 5 and 6 will usually be contained within a single cable. The multi-pin socket 12 has a first earth pin 29, a second earth pin 30, and main line pins 31 and 32 corresponding to the pins of the plug. The protective unit has a metal casing 13 which is connected, by way of a terminal 14 on it and of a wire 15, to the local earth (solid earth) associated with the source of supply. In addition to the multi-pin socket 12, the protective unit comprises an earth leakage circuit-breaker 16 having a single trip coil 17, a voltage step-down transformer 18, a monitoring relay 19 of an electromagnetic type operable by alternating current and having a single change-over contact spring set 20, and a thermal relay 21 having a single make contact 22 and of the kind in which a resistive winding 35 surrounds and heats a bi-metallic strip. The earth leakage circuit-breaker 16 is connected so that its contacts when closed connect the main line wires 23 and 24 of the alternating current supply through to the main line pins of the multi-pin socket 12. The main line wire 23 of the alternating current supply is a phase wire, and there is normally a substantial voltage between this wire and earth. The wire 24 may be a neutral wire. The primary winding 25 of the transformer 18 is connected to be continuously energised from the supply independently of the circuit-breaker. The secondary voltage may be of the order of 12 volts. The trip coil 17 of the circuit-breaker 16 is connected between an auxiliary earth 27 (to which it is connected by a wire 28 insulated from the solid earth) and the moving contact of the change-over contact springset 20 of the monitoring relay 19. In the Figure, the contact springset 20 is shown in the unoperated condition. The back contact of the contact springset 20 is connected to that one of the main line wires on the protected circuit side of the circuit-breaker 16 which is connected through to wire 23 during periods in which the circuit-breaker contacts are closed. The front contact of the contact springset 20 is connected to the first earth pin 29 of the multi-pin socket 12. One end of the secondary winding 26 of the transformer 18 is connected to the metal casing 13 by way of a terminal 33 on this casing, and the other end of the winding 26 is connected to the first earth pin 29 of the multi-pin socket through the winding 34 of the monitoring relay. One end of the resistive winding 35 of the thermal relay 21 is connected to the metal casing 13 by way of a terminal 36 on this casing, and the other end of winding 35 is connected to the second earth pin 30 of the multi-pin socket. The make contact 22 of the thermal relay is connected so that it on operation short-circuits the secondary winding 26 of the transformer 18, the transformer being of a type rated for continuous operation with a short-circuited secondary. The short-circuit includes the path between the terminals 33 and 36 which is provided by the casing 13.

The monitoring relay 19 is normally maintained operated by current supplied by the transformer 18 and flowing in a circuit including the first earth pin 29 of the multi-pin socket 12, the first earth pin 7 of the multi-pin plug 11, the first earth wire 3 of the protected circuit, the metal casing 2, the second earth wire 4 of the protected circuit, the second earth pin 8 of the plug 11, the second earth pin 30 of the socket 12, the winding 35 of the thermal relay 21, terminal 36, the metal casing 13, and the terminal 33. The current flowing in the winding 35 of the thermal relay 21 in these circumstances is insufficient to bring about effective operation of the make contact 22 of the relay.

If the continuity of the earth wire system of the protected circuit is broken, the monitoring relay 34 is released, and the contact springset 20 assumes the unoperated condition in which it is shown in the Figure. The trip coil 17 of the earth leakage circuit-breaker 16 is thus connected between the auxiliary earth 27 and the main line wire 23 of the alternating current supply, with the result that the trip coil is effectively energised to trip the circuit-breaker and thereby bring about the disconnection of the protected circuit from the alternating current supply.

Upon the occurrence in the protected circuit of an earth leakage fault which is sufficiently serious to cause the potential of the first earth wire 3 to differ by more than a predetermined amount (for example 22 volts) from that of the auxiliary earth 27, the trip coil 17 of the earth leakage circuit-

breaker 16 is immediately effectively energised by virtue of its normal connection between the wire 3 and the auxiliary earth 27, this normal connection including of course the normally-operated contact 20.

Upon the occurrence in the protected circuit of an earth leakage fault which is not sufficiently serious to bring about the immediate effective energisation of the trip coil 17 of the earth leakage circuit-breaker 16 as just described, but which is nevertheless such as to produce the flow of a substantial earth leakage current (for example exceeding 2 amperes) in the second earth wire 4, the thermal relay 35 operates provided that the fault persists for a sufficient time and at its make contact 22 short-circuits the secondary winding 26 of the transformer 18. The monitoring relay 19 is consequently released with the result that the trip coil 17 of the circuit-breaker 16 is effectively energised.

Referring now to Fig. 2, this shows how the circuit of a further contemplated specific embodiment differs from the circuit of Fig. 1. Apart from the connections actually shown in Fig. 2, the circuit of this further embodiment is identical with that of Fig. 1. In the case of the embodiment now being considered, the protective unit is transportable, and is connected to a fixed point of supply 37 by a cable comprising a first earth wire 38, a second earth wire 39, and main line wires 40 and 41. The main line wires 40 and 41 and the second earth wire 39 correspond respectively to the wires 23, 24, and 15 of Fig. 1, the wire 39 being connected to a terminal 42 on the metal casing 13. In this case the circuit in which the monitoring relay is normally maintained operated, instead of passing from the left-hand terminal of the secondary winding 26 of the transformer 18 directly to a terminal on the metal casing 13, includes the first earth wire 38 (connected to solid earth), a connection at the supply point 37 between solid earth and the second earth wire 39, and terminal 42. If the continuity of the earth wire system including wires 38 and 39 is broken, the monitoring relay is released with the results previously described.

What we claim is :—

1. Electric protective cut-out arrangements for automatically disconnecting a protected circuit from a source of supply on the occurrence of an earth leakage fault in the protected circuit wherein an earth leakage circuit-breaker serves for connecting the protected circuit to the source of supply, and wherein a trip coil of the earth leakage circuit-breaker is normally connected between an auxiliary earth and an earth wire of the protected circuit, and wherein the winding of a thermal relay is normally connected between the said earth wire and the local earth associated with the source of supply, this thermal relay serving to bring about the effective energisation of the trip coil of the earth leakage circuit-breaker in response to a persistent earth leakage fault current in the protected circuit which is not sufficiently serious to cause this trip coil to be effectively energised by virtue of its connection between the said earth wire and the auxiliary earth.

2. Electric protective cut-out arrangements according to Claim 1 wherein the thermal relay on operation brings about the effective energisation of the trip coil of the earth leakage circuit-breaker by bringing about the connection of this trip coil between the auxiliary earth and one of the main line wires of the protected circuit.

3. Electric protective cut-out arrangements according to Claim 1 wherein the thermal relay on operation brings about the effective energisation of the trip coil of the earth leakage circuit-breaker by bringing about the release of a monitoring relay which is normally maintained operated in dependence upon the continuity of the earth wire system of the protected circuit, this monitoring relay having contacts which whilst operated connect the trip coil of the earth leakage circuit-breaker between the auxiliary earth and the said earth wire of the protected circuit, and which whilst unoperated connect this trip coil between the auxiliary earth and one of the main line wires of the protected circuit.

4. Electric protective cut-out arrangements substantially as described and as illustrated in Fig. 1, or in Fig. 1 as modified by Fig. 2, of the accompanying drawings.

SIEMENS ELECTRIC LAMPS AND SUPPLIES LIMITED.

By their Attorney :—

W. G. COVELL.

PROVISIONAL SPECIFICATION.

Improvements relating to Electric Protective Cut-Out Arrangements.

We, SIEMENS ELECTRIC LAMPS AND SUPPLIES LIMITED, of Caxton House, Tothill Street, Westminster, London, S.W.1, a Company registered under British law, do hereby declare this invention to be described in the following statement :—

This invention relates to electric protective cut-out arrangements, and has in view the

provision of improved electric protective cut-out arrangements for automatically disconnecting a protected circuit from a source of supply on the occurrence of an earth leakage fault in the protected circuit.

The earth leakage protective cut-out arrangements of the invention are such that disconnection of a protected circuit is effected substantially immediately on the occurrence in the protected circuit of an earth leakage fault which is sufficiently serious to cause the potential of an earth wire of the protected circuit to differ by more than a predetermined amount from that of an auxiliary earth, and is also effected in response to a less serious earth leakage fault in the protected circuit provided that the fault persists for a sufficient time. The preferred earth leakage protective cut-out arrangements embodying the invention are further such that the continuity of the earth wire system of the protected circuit is continuously monitored.

According to one feature of the invention, electric protective cut-out arrangements for automatically disconnecting a protected circuit from a source of supply on the occurrence of an earth leakage fault in the protected circuit are such that an earth leakage circuit-breaker serves for connecting the protected circuit to the source of supply, that a trip coil of the earth leakage circuit-breaker is normally connected between an auxiliary earth and an earth wire of the protected circuit, and that the winding of a thermal relay is normally connected between the said earth wire and the local earth (usually termed the solid earth) associated with the source of supply, this thermal relay serving to bring about the effective energisation of the trip coil of the earth leakage circuit-breaker in response to a persistent earth leakage fault current in the protected circuit which is not sufficiently serious to cause this trip coil to be effectively energised by virtue of its connection between the said earth wire and the auxiliary earth.

According to another feature of the invention, the thermal relay on operation brings about the effective energisation of the trip coil of the earth leakage circuit-breaker by bringing about the connection of this trip coil between the auxiliary earth and one of the main line wires of the protected circuit.

According to a further feature of the invention, the thermal relay on operation brings about the effective energisation of the trip coil of the earth leakage circuit-breaker by bringing about the release of a monitoring relay which is normally maintained operated in dependence upon the continuity of the earth wire system of the protected circuit, this monitoring relay having contacts which whilst operated connect the trip coil of the earth leakage circuit-breaker between the auxiliary earth and the said earth wire of the protected circuit, and which whilst unoperated connect this trip coil between the auxiliary earth and one of the main line wires of the protected circuit.

By way of example, a contemplated specific embodiment of the invention will now be briefly described. This embodiment takes the form of electric protective cut-out arrangements for use with an alternating current supply and comprising a protective unit having a multi-pin socket into which is inserted the corresponding multi-pin plug of a plug-terminated circuit to be protected. The protected circuit will be assumed to comprise apparatus having a metal casing which is connected by a first earth wire to a first earth pin of the plug and which is connected independently by a second earth wire to a second earth pin of the plug. The remaining pins of the plug are main line pins connected by main line wires of the protected circuit to terminals within the casing just mentioned. The multi-pin socket has a first earth pin, a second earth pin, and main line pins corresponding to the pins of the plug. The protective unit has a metal casing which is connected to the local earth (solid earth) associated with the source of supply. In addition to the multi-pin socket, this unit comprises an earth leakage circuit-breaker having a single trip coil, a voltage step-down transformer, a monitoring relay of an electromagnetic type operable by alternating current and having a single change-over contact springset, and a thermal relay having a single make contact and of the kind in which a winding surrounds and heats a bi-metallic strip. The earth leakage circuit-breaker is connected so that its contacts when closed connect the main line wires of the alternating current supply through to the main line pins of the multi-pin socket. The primary winding of the transformer is connected to be continuously energised from the supply independently of the circuit-breaker. The secondary voltage may be of the order of 12 volts. The trip coil of the circuit-breaker is connected between an auxiliary earth (to which it is connected by a wire insulated from the solid earth) and the moving contact of the change-over contact springset of the monitoring relay. The back contact of the said change-over contact springset is connected to one of the main line wires on the protected circuit side of the circuit breaker, and the front contact is connected to the first earth pin of the multi-pin socket. One end of the secondary winding of the transformer is connected to the metal casing of the unit, and the other end is connected to the first earth pin of the multi-pin socket through the winding of the monitoring relay. The winding of the thermal relay is connected between the metal casing of the unit and the second

earth pin of the multi-pin socket. The make contact of the thermal relay is connected so that it on operation short-circuits the secondary winding of the transformer, the transformer being of a type rated for continuous operation with a short-circuited secondary.

The monitoring relay is normally maintained operated by current supplied by the transformer and flowing in a circuit including the first and second earth wires of the protected circuit and the winding of the thermal relay. The current flowing in the winding of the thermal relay in these circumstances is insufficient to bring about effective operation of the make contact of the relay. If the continuity of the earth wire system of the protected circuit is broken, the monitoring relay is released to connect the trip coil of the earth leakage circuit-breaker between the auxiliary earth and one of the main line wires and so cause the trip coil to be effectively energised.

Upon the occurrence in the protected circuit of an earth leakage fault which is sufficiently serious to cause the potential of the first earth wire to differ by more than a predetermined amount (for example 22 volts) from that of the auxiliary earth, the trip coil of the earth leakage circuit-breaker is immediately effectively energised by virtue of its normal connection between the first earth wire and the auxiliary earth.

Upon the occurrence in the protected circuit of an earth leakage fault which is not sufficiently serious to bring about the immediate effective energisation of the trip coil of the earth leakage circuit-breaker as just described, but which is nevertheless such as to produce the flow of a substantial earth leakage current (for example exceeding 2 amperes) in the second earth wire, the thermal relay operates provided that the fault persists for a sufficient time and at its make contact short-circuits the secondary winding of the transformer. The monitoring relay is consequently released with the result that the trip coil of the circuit-breaker is effectively energised.

SIEMENS ELECTRIC LAMPS AND SUPPLIES LIMITED.
By their Attorney :—
W. G. COVELL.

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735,908 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

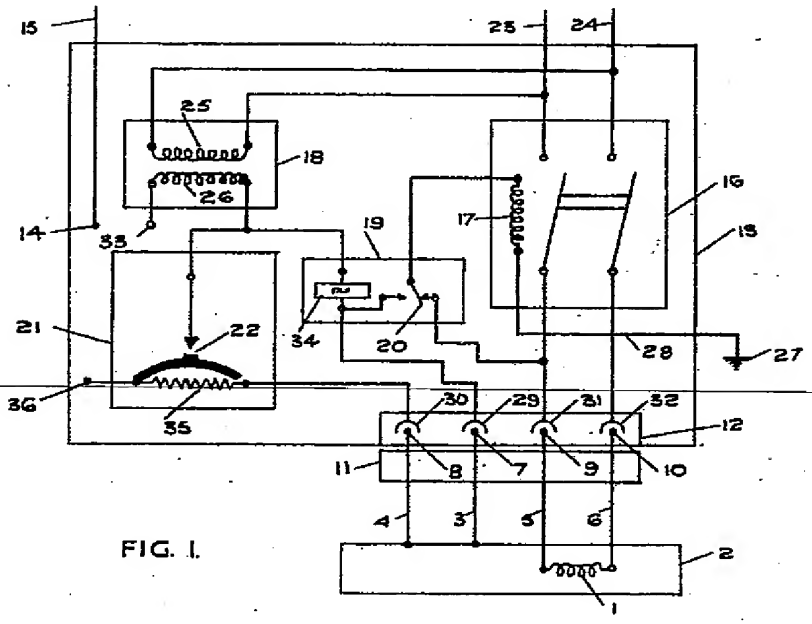

FIG. 1.

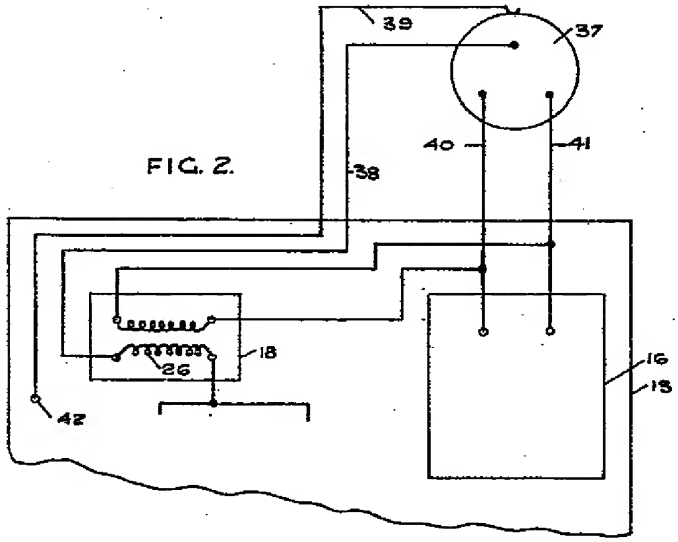

FIG. 2.